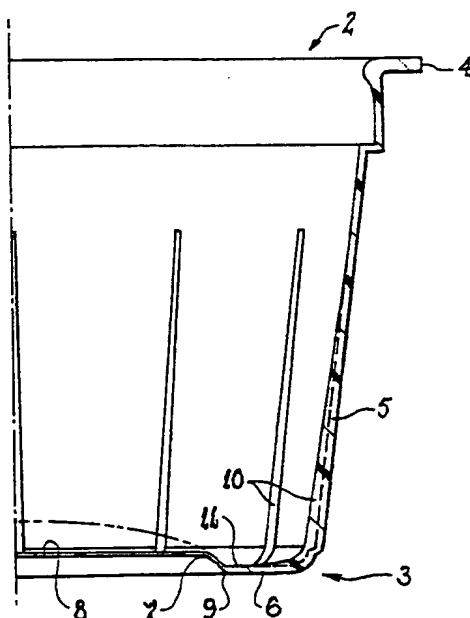




## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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(21) International Application Number: PCT/AU93/00255 (22) International Filing Date: 1 June 1993 (01.06.93) (30) Priority data: PL 2763                      2 June 1992 (02.06.92)                      AU (71) Applicant (for all designated States except US): ACI OPERATIONS PTY. LTD. [AU/AU]; 15th Floor, 390 St. Kilda Road, Melbourne, VIC 3004 (AU). (72) Inventors; and (75) Inventors/Applicants (for US only) : PAWLIW, Eugene [AU/AU]; 64 Gladstone Parade, Riverstone, NSW 2765 (AU). PHILIP, Gigy, Jacob [AU/AU]; 7 Lemongrass Place, Cherrybrook, NSW 2126 (AU).	(74) Agent: PHILLIPS ORMONDE & FITZPATRICK; 367 Collins Street, Melbourne, VIC 3000 (AU). (81) Designated States: AU, JP, NZ, US, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE). Published With international search report.	

(54) Title: CONTAINER



## (57) Abstract

A container comprising a side wall or walls, a base and means for sealing the container; the said base including a standing ring on which the container is adapted to stand and a diaphragm portion which extends from the inner edge of the standing ring thus forming a central portion of the base of the container; said diaphragm being adapted to axially deform by bowing either inwardly or outwardly preferentially to the side wall or walls so to accommodate changes in pressure in the container wherein the portion of the diaphragm adjacent to and extending from the inner edge of the standing ring is substantially continuous.

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CONTAINER

This patent application relates to plastic containers and in particular plastic containers which  
5 undergo a change in internal pressure between filling and use by the consumer.

The processes used in packaging materials in containers and the nature of the materials themselves often place severe requirements on the structure and  
10 rigidity of containers.

For example in hot filling containers with food products the food is typically at a temperature of between 80 to 95°C when introduced into the container. If the container is sealed shortly thereafter a significant  
15 vacuum within the container is created on cooling. If the container is not sufficiently strong, side wall panelling can result giving the container an unattractive appearance. In many cases rupturing can occur resulting in spoiling of the food and possible health complications  
20 for the consumer.

In consequence of the above it has generally been necessary to use containers of sufficient rigidity to withstand pressure reduction.

The same difficulties can be caused by volatile  
25 materials which lead to an increase in pressure. However, the invention will be discussed with reference mainly to hot fill containers although the invention is not restricted thereto.

In packaging of foodstuffs it is preferable to leave  
30 an air space for the convenience of the end user. The vacuum generated in this air space resulting from cooling after hot filling exacerbates the problems of container failure or side wall panelling.

It is an object of the present invention to provide  
35 a plastics container which is suitable for containing foodstuffs which are introduced whilst hot, sealed and thereafter cooled without significant side wall deformation. It is also an object of the invention to provide a plastics container suitable for retort.

According to the present invention there is provided a container comprising a side wall or walls, a base and means for sealing the container; the said base including a standing ring on which the container is adapted to stand and a diaphragm portion which extends from the inner edge of the standing ring across the base of the container and which is adapted to axially deform by bowing either inwardly or outwardly preferentially to the side wall or walls so to accommodate changes in pressure in the container wherein the portion of the diaphragm adjacent to and extending from the inner edge of the standing ring is substantially continuous.

The portion of the diaphragm adjacent to the inner edge of the standing ring should be continuous so to allow substantially uniform bowing of the diaphragm portion from the inner edge of the standing ring. Grooves, corrugations or other disruptions in the substantially continuous profile in this region should be avoided.

Preferably, the diaphragm portion is uniformly thinner than the container side wall or walls, so to encourage or cause the preferential deformation of this portion of the container. Alternatively or in addition, the side walls may be reinforced by internal ribbing or the like.

The diaphragm portion is preferably connected to the inner edge of the standing ring in such manner that inward or outward bowing of the diaphragm will not disrupt the stability of the container (i.e. a continuous circumferential portion of the standing ring will present a contact area on which the container will be adapted to stand, notwithstanding deformation of the diaphragm). Preferably, the diaphragm portion is connected to the inner edge of the standing ring by an upwardly arched portion which is adapted to allow deformation of the diaphragm without disrupting the stability of the container.

The diaphragm is preferably essentially planar and transverse to the axis of the container. The diaphragm is desirably recessed axially upwardly from the bottom of the

container under ambient conditions.

The diaphragm portion of the base typically comprises a portion which is less than 80% of the minimum thickness of the side wall. 50 to 80% of this minimum  
5 thickness is preferred.

Preferably the base diameter of container of the invention is less than the top diameter with the base diameter to top ratio diameter typically being in the range of from 0.65 to 1.0.

10 In one embodiment the preferred containers of the invention have a side wall thickness ranging between 0.35mm to 0.70mm and have a ratio of base wall to side wall thickness in the range of 0.5 to 0.75.

15 In another embodiment the containers of the invention have a side wall thickness ranging between 0.70 mm to 1.0 mm and have a ratio of base wall to side wall thickness in the range of 0.3 to 0.5.

The material distribution is such that the diaphragm portion of the base and its connection to the standing  
20 ring may be continuous and yet preferentially deform to the side walls. This is useful in preventing side wall panelling and seal rupturing in containers which are hot filled, retorted or filled with volatile liquids and avoids the need to specifically mould special creases,  
25 grooves, corrugations or the like to facilitate the required preferential deformation.

The invention also allows for ribbing to be incorporated into the container structure so as to assist with the prevention of sidewall panelling and seal  
30 rupturing.

Preferably the container comprises a multiplicity of reinforcing ribs in the standing ring. Preferably the ribs extend downwardly from the side wall of the container and towards the centre of the base across at least the  
35 outer portion of the standing ring. The reinforcing ribs provide resilient resistance to deformation of the standing ring. The ribs may extend across only a portion of the standing ring but preferably will extend at least half the width of the standing ring. The ribs may

increase in thickness toward the outer edge of the standing ring to increase resistance to deformation of the outer portion.

5 The standing ring preferably comprises an essentially planar surface and is most preferably of a width in the range of from 10 to 40% of the base radius. The length of the ribs in the standing ring is therefore typically at least 5% of the base radius more preferably at least 10% of the base radius.

10 Preferably the inner edge of the standing ring is free of ribbing so that under a vacuum slight deformation of the inner edge of the standing ring occurs to provide a broad area over which the change in pressure is dissipated.

15 Preferably the inner edge of the standing ring is concavely curved and has a radius of curvature in the range of from 1 to 5mm. It is preferred that the ribs are disposed on the inner side of the container providing stability and an even outer surface for labelling.

20 The ribs preferably extend into the container side wall and preferably to at least one third of the container height. The ribs may narrowly taper toward the top of the container.

25 The invention also allows for a closure to be fused onto the container by mechanical, heat or ultrasonic means, where the closure may additionally perform the function of a second deformable diaphragm. The closure may assist in dissipating internal pressures or internal vacuums in containers where the base also acts as a diaphragm hence assisting in preventing sidewall panelling.

30 In a further embodiment the invention there is provided a container as described above and provided with a lid forming an airtight seal therewith and containing a liquid product.

35 Preferably the lid and base diaphragm co-act to dissipate the change in pressure when said container and product are heated to a temperature of at least up to about 95°C and returned to ambient conditions.

The container is preferably filled with from 70 to 100% of its brimfull capacity with a liquid product.

The containers and lids may be produced by the following processes:-

- (i) thermoforming
- (ii) injection moulding
- 5 (iii) injection blow moulding

The invention enables the manufacture of light weight containers (sealed with a flexible membrane or seamed with a metal end) for filling of hot liquid.

10 Preferably the container is formed from a sheet of plastics material by a process which includes the base forming portion of the sheet being formed into a diaphragm portion which is upwardly deformable to accomodate a reduction in pressure when the container is sealed with a hot product therein and cooled to ambient temperature.

15 Examples of plastics materials include polyethylene, polypropylene, ethylene propylene copolymers and polyesters such as PET.

In containers which are hot filled, the possibility of deformation of the side wall and rupturing of the seal

20 increases with increasing fill temperatures and decreasing fill volumes. This is due to the internal vacuum developed with the condensation of steam in the headspace as the product cools.

The invention allows production of containers in

25 which the base flexes inwardly to dissipate the internal vacuum hence preventing side wall penelling and rupturing of the seal.

The invention also enables the production of containers seamed with a metal end or sealed with a

30 flexible membrane for retort applications.

During a retort process, the product is heated to temperatures of typically about 120°C. The internal pressures in the container increase with increasing processing temperature and decreasing fill volume. Poor

35 control of overpressures in the retort can mean the rupturing of the metal end or flexible membrane seal. On subsequent cooling of the product after retort, internal vacuums develop in headspace with the condensation of steam.

The invention enables production of containers in which the base flexes to dissipate the internal pressure created during the retort process so to dissipate the internal vacuum created in the headspace as the product  
5 cools.

A further advantage of the invention is that it allows a head-space preferably of at least 5% by volume (more preferably at least 10%) to be provided between the under surface of the closure and the surface of the liquid  
10 product. Typically the head-space is up to 30% of the total volume.

The invention further provides a process for preparing a filled container comprising providing a sheet of plastics material deforming the sheet to provide a  
15 container comprising a side wall and a base wall comprising a portion which is axially deformable to accomodate a reduction in pressure when the container is filled and sealed.

Preferably the container will be essentially free of  
20 side wall deformation when filled to 70 to 100% of brimfull capacity with a hot fill product (for example at 90°C) sealed and allowed to return to ambient conditions.

One example of a forming process which may be used in preparing the containers of the invention is disclosed  
25 in Australian patent no. 534,392 in the name of Hitek Limited.

The invention is now described with reference to a preferred embodiment of the invention as illustrated in the attached drawings in which:-

30 Figure 1 is a side view of a container of the invention.

Figure 2 is a view of half of a longitudinal section of a container of the invention.

Figure 3 is a bottom view of a container of the  
35 invention.

Referring to the drawings there is shown in Figure 1 a container 1 having an open end 2 and a closed base 3. The container has a lip 4 adjacent the opening to facilitate sealing of the container 1 by a closure such as



a foil membrane (not shown).

The side walls 5 of the container preferably converge toward the base.

As shown in Figures 2 and 3 the base comprises a standing ring 6 an upwardly arched portion 7 and a planar diaphragm 8 transverse to the axis of the container.

It will be noted that the diaphragm portion 8 extends substantially continuously from the inner edge 9 of the standing ring 6 without any grooving or corrugation adjacent to this connection.

The thickness of the container wall in the standing ring portion is usually slightly less than the side wall thickness and is preferably at least 0.2mm. Typically, in a 5 ounce container the side wall thickness is about 0.55 mm and the standing ring portion thickness is about 0.50 mm.

The thickness of the upwardly arched portion 7 is preferably less than the thickness of side walls 5 and most preferably thins down to the thickness of planar diaphragm 8.

In the embodiment described above, the upwardly arched portion 7 would be about 0.4 mm and the diaphragm 8 about 0.2 mm.

The planar portion provides a diaphragm and is usually from about 30 to about 80% of the wall thickness of the side wall.

The container may be hot filled through opening 2 and sealed with a closure. The closure may be a metal foil, metal plastic laminate or plastic film or the like.

On cooling the diaphragm portion 8 deforms upwardly to accomodate a reduction in pressure in the container. The deformed diaphragm bows inwardly (shown as a broken line in Figure 2) and thus alleviates pressure on the side wall 5 preventing panelling and cracking.

On retort or in other circumstances where the internal pressure of the container is higher than ambient temperature, diaphragm portion 9 is adapted to preferentially bow downwardly.

The container includes a multiplicity of ribs 10

circumferentially spaced on the inner side of the container and extending across the outer portion 11 of the standing ring 6 preferably at least half way across as shown in Figure 3. The ribs also extend at least one  
5 third of the way up the side of the container.

There is preferably a circumferential spacing in the range of from 1 to 2 cm between adjacent ribs the ribs being in the range of from 1 to 2mm wide.

The thickness of the ribs (not including the side  
10 wall) is from about 0.1 to 1.5 times the side wall thickness.

#### EXAMPLE

A container was prepared having the following characteristics

15

Weight  $7g \pm 0.25mm$

Height  $49.4 \pm 0.55 mm$

Flange  $1.27 \pm 0.05 mm$

Base wall thickness  $0.425 \pm 0.025 mm$

20

Capacity  $145 \pm 5ml$

The container was in accordance with the general shape depicted in figures 1 to 3. The container was hot filled with food at  $95^{\circ}C$  and sealed with a flexible  
25 membrane. On cooling the base flexed upwardly to dissipate reduced internal pressure preventing side wall panelling.

Preferably the side wall thickness of the container will be less than 1mm. Preferably less than 0.8mm.

30

Finally, it is to be understood that various other modifications and/or alterations may be made without departing from the spirit of the present invention as outlined herein.

35

Claims

1. A container comprising a side wall or walls, a base and means for sealing the container; the said base including a standing ring on which the container is adapted to stand and a diaphragm portion which extends from the inner edge of the standing ring thus forming a central portion of the base of the container; said diaphragm being adapted to axially deform by bowing either inwardly or outwardly preferentially to the side wall or walls so to accommodate changes in pressure in the container wherein the portion of the diaphragm adjacent to and extending from the inner edge of the standing ring is substantially continuous.
2. A container as claimed in claim 1 wherein the portion of the diaphragm adjacent to the inner edge of the standing ring does not comprise any grooves, corrugations or other disruptions in its profile.
3. A container as claimed in either one of claims 1 or 2 wherein the diaphragm portion is uniformly thinner than the container side wall or walls.
4. A container as claimed in any one of the preceding claims wherein the side walls are reinforced by internal ribbing.
5. A container as claimed in any one of the preceding claims wherein the diaphragm portion is connected to the inner edge of the standing ring in such manner that inward or outward bowing of the diaphragm will not disrupt the stability of the container.
6. A container as claimed in claim 5 wherein the diaphragm portion is connected to the inner edge of the standing ring by an upwardly arched portion.
7. A container as claimed in any one of the preceding claims wherein the diaphragm portion of the base comprises a portion which is less than 80% of the minimum thickness of the side wall.
8. A container as claimed in claim 7 wherein the diaphragm portion of the base comprises a portion which is between 50 to 80% of the minimum thickness of the side

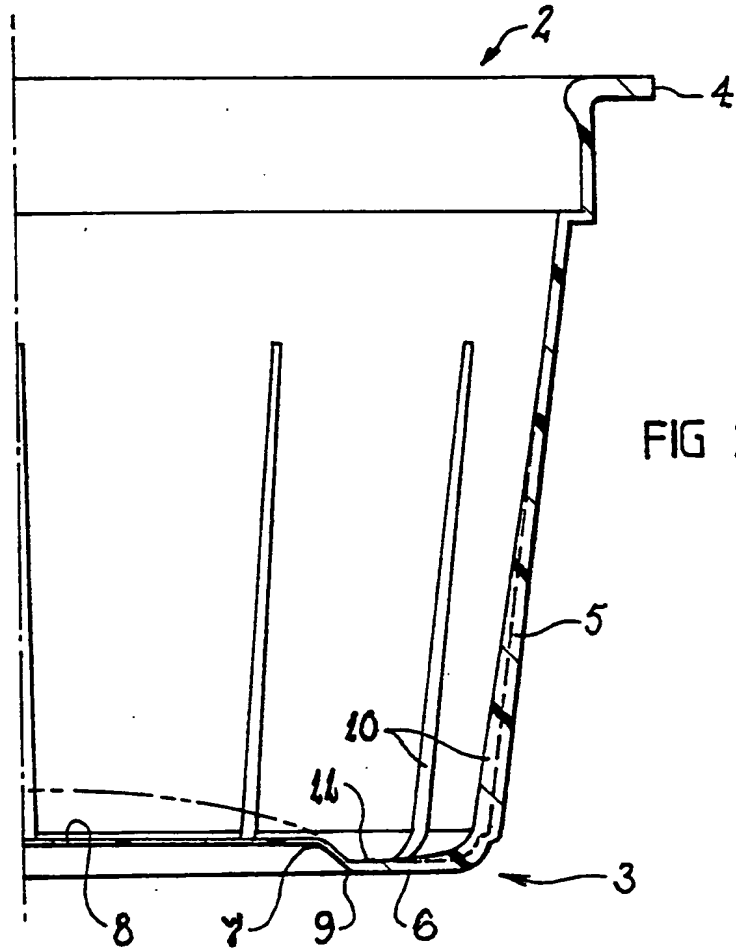
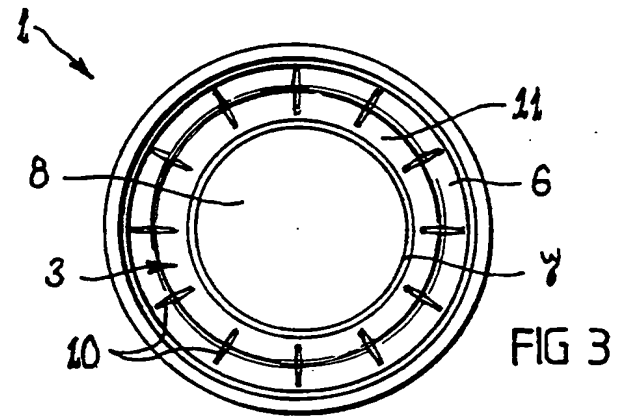
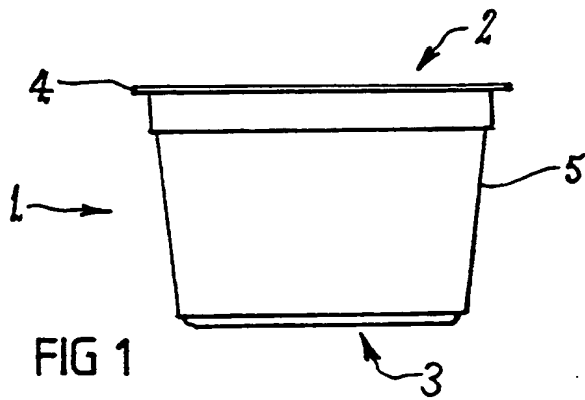
wall.

9. A container as claimed in any one of the preceding claims wherein the base diameter of the container is less than the top diameter and the base diameter to top diameter ratio is in the range of from 0.65 to 1.0.
10. A container as claimed in any one of the preceding claims wherein the side wall thickness ranges between 0.35 to 0.70 mm and the ratio of base wall to side wall thickness is in the range of 0.5 to 0.75.
11. A container as claimed in any one of claims 1 to 10 wherein the thickness of the side wall or walls is between 0.70 to 1.0 mm and the ratio of the base wall to the side wall thicknesses is in the range of between 0.3 to 0.5.
12. A container as claimed in any one of the preceding claims comprising a plurality of reinforcing ribs in the standing ring.
13. A container as claimed in claim 12 wherein each of the said ribs extend from the side wall of the container toward the centre of the base across at least the outermost portion of the standing ring.
14. A container as claimed in any one of the preceding claims wherein the standing ring comprises an essentially planar surface and has a width in the range of between 10 to 40% of the base radius.
15. A container substantially as hereinbefore described with reference to what is shown in any one of Figures 1 to 3.

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## INTERNATIONAL SEARCH REPORT

International application No.

PCT/AU 93/00255

<b>A. CLASSIFICATION OF SUBJECT MATTER</b> Int. Cl. <sup>5</sup> B65D 81/18, B65D 81/20  According to International Patent Classification (IPC) or to both national classification and IPC				
<b>B. FIELDS SEARCHED</b>  Minimum documentation searched (classification system followed by classification symbols) IPC: B65D 81/18, B65D 81/20, B65D 81/22  Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched AU: IPC as above; B65D 1/10-1/20  Electronic data base consulted during the international search (name of data base, and where practicable, search terms used)				
<b>C. DOCUMENTS CONSIDERED TO BE RELEVANT</b>				
<b>Category*</b>	<b>Citation of document, with indication, where appropriate, of the relevant passages</b>	<b>Relevant to Claim No.</b>		
X Y	GB 1600006 (METAL BOX LIMITED) 14 October 1981 (14.10.81) page 1, column 2, page 2, column 2	1,2,5,6,14 4		
X	US 3409167 (AMERICAN CAN COMPANY) 5 November 1968 (05.11.68) page 1, paragraph 3, fig 5, page 4, paragraph 3	1,3,5,7-11		
X Y	AU,B,84819/82 (554618) (AMERICAN CAN COMPANY) 23 December 1982 (23.12.82) page 3, paragraph 4 page 4, lines 27-33	1,5,9 12,13		
<div style="display: flex; justify-content: space-between;"> <div> <input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C.         </div> <div> <input checked="" type="checkbox"/> See patent family annex.         </div> </div>				
<table style="width: 100%; border: none;"> <tr> <td style="width: 50%; vertical-align: top;"> <p>* Special categories of cited documents :</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> </td> <td style="width: 50%; vertical-align: top;"> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art</p> <p>"&amp;" document member of the same patent family</p> </td> </tr> </table>			<p>* Special categories of cited documents :</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p>	<p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art</p> <p>"&amp;" document member of the same patent family</p>
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Date of the actual completion of the international search 23 August 1993 (23.08.93)		Date of mailing of the international search report 10 SEP 1993 (10.09.93)		
Name and mailing address of the ISA/AU  AUSTRALIAN INDUSTRIAL PROPERTY ORGANISATION PO BOX 200 WODEN ACT 2606 AUSTRALIA  Facsimile No. (06) 2853929		Authorized officer    G.M. COX  Telephone No. (06) 2832484		

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/AU 93/00255

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate of the relevant passages	Relevant to Claim No.
X	EP 0115380 (AMERICAN CAN COMPANY) 8 August 1984 (08.08.84) page 7, paragraph 3, fig 2, page 13, line 19 - page 14, line 14	1,5,9
A	GB 2190892 (METAL BOX PUBLIC LIMITED COMPANY) 2 December 1987 (02.12.87) page 1, lines 40-47	1,2,5,6
Y	AU 34826/84 (GENTILI VITTORIO) 30 May 1985 (30.05.85) page 9, paragraph 1	4
Y	AU 45561/79 (534974) (ROTOPLAS LTD) 18 October 1979 (18.10.79) page 2, lines 1-3	12,13

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